

MONITORING OF PATENT DOCUMENTS BY EVALUATING THE EVOLUTION OF THE TECHNOLOGIES INVOLVED IN PAINTS CONTAINING BIOCIDES

MONITORAMENTO DE DOCUMENTOS DE PATENTES AVALIANDO A EVOLUÇÃO DAS TECNOLOGIAS ENVOLVIDAS EM TINTAS QUE CONTÊM BIOCIDAS

Marcello Carvalho dos Reis¹; Patricia Carvalho dos Reis²; Germana Nogueira Bezerra³; Maria Elisa Marciano Martinez⁴

¹ Meteora - ncarv.reis@gmail.com

² Instituto Nacional da Propriedade Industrial - INPI – Rio de Janeiro/RJ – Brasil – pcreis@inpi.gov.br

³ Meteora - germana.nb@gmail.com

⁴ Instituto Nacional da Propriedade Industrial - INPI – Rio de Janeiro/RJ – Brasil – melisa@inpi.gov.br

Abstract

This article aims to conduct a technology mapping through the monitoring of patent documents by evaluating the evolution of the technologies involved in paints containing biocides in order to provide insight and to strengthen support for making important decisions based on facts and concrete evidence on the dynamics of technological development of paints containing biocides sector. They were initially used data extracted from patent documents on the INPI-BR nationwide database, and the codes of the international patent classification (IPC): subgroup "C09D5/14" and "C09K5/16". There were retrieved a total of 145 patent documents, in general, the main form of deposit used is the international deposit (PCT and CUP). As for the countries of origin, we have a concentrated distribution since the first two countries hold 72% of the deposited patent documents; they are United States (40%) and Brazil (32%).

Key-words: paint; biocide; patenting documents; technological mapping.

Resumo

Este artigo tem como objetivo realizar um mapeamento tecnológico por meio do monitoramento de documentos de patentes, avaliando a evolução das tecnologias envolvidas em tintas contendo biocidas, a fim de fornecer informações e fortalecer o apoio à tomada de decisões importantes com base em fatos e evidências concretas sobre a dinâmica da tecnologia. desenvolvimento de tintas contendo o setor de biocidas. Foram utilizados inicialmente dados extraídos de documentos de patentes no banco de dados nacional do INPI-BR e os códigos da classificação internacional de patentes (IPC): subgrupo "C09D5/14" e "C09K5/16". Foram recuperados 145 documentos de patentes, em geral, a principal forma de depósito utilizada é o depósito internacional (PCT e CUP). Quanto aos países de origem, temos uma distribuição concentrada, pois os dois primeiros países detêm 72% dos documentos de patentes depositados; eles são Estados Unidos (40%) e Brasil (32%).

Palavras-chave: tinta, biocida; documentos de patentes; mapeamento tecnológico.

1. Introduction

The industry, in general, has been looking for an innovative strategy to differentiate itself in this extremely competitive environment, in the case of the paint industry; one of the actions that seek differentiation is the incorporation of biocides in paints. In order to evaluate the innovation strategies of the paint industry containing biocides, it is the obtaining of the technological information through the analysis of the patent documents.

2. Contextualization About Paints Containing Biocides

The use of biocides to prevent product deterioration began with Ancient Egypt, Ancient China, Alexander the Great and Ancient Greek (WYPYCH and WYPYCH, 2015).

The biocides terminology has a wide spectrum of definitions, due to the multiplicity of views about these chemical substances, which can be used in different areas, from agriculture, medicine, chemistry, economics, among other areas of application, including: paint and coating, ink, adhesive and sealant, plastic, polymer emulsion, and, wood treatment (MORAGAS, SCHNEIDER, 2003; SAUER, 2017). One of the definitions is that biocide is any chemical or agent that kills organisms (ROBINSON, 2005)

According to BULL & HATHAWAY (1986), biocidal designation is used to designate artificially synthesized chemicals to restrain the action of invasive pests (bacteria, vegetables, fungi, insects, etc.) that interfere with the quantity or quality of food, flowers, woods, dispersions of pigments, fibers, among other diverse products; both in production, and in the storage or transportation of these products, leading to considerable economic losses. One of the areas in which biocides are used is that of the paint industry, since it is formed by different qualities and quantities of raw materials (pigments, binders, liquids and additives) containing compounds that can serve as nutrients for the growth of microorganisms and, if they are in the presence of requirements, as explained in Table 1, colony growth may occur. This colonization provokes the impairment of the decorative and protective functions of the paint, as well as physical changes in the product, such as changes in the viscosity of the product, bad smell due to the proliferation of the microorganisms and in some cases, to the production of gas, such as dioxide of carbon, which can lead to an increase in pressure inside the paint cans, for example, causing damage to the packaging (MACHEMER, 1989).

Table 1 – Characteristics for the growth of microorganisms

Characteristics	Bacteria	Fungi	Algae
Light	It is not necessary	It is not necessary	Need
Ideal pH	Slightly alkaline	Slightly alkaline	Neutral
Ideal temperature	25°C – 40°C	20°C – 35°C	15°C – 35°C
Nutrients	C, H, N	C, H, N	CO ₂
Oxygen	Aerobic or anaerobic	Aerobic	Aerobic
Water	Liquid or vapor	Liquid or vapor	Liquid or vapor

Fonte: Adapted from Matteucci (2009).

The contamination can be caused by factors during its manufacture, such as contamination of water, raw materials and equipment used, as well as the possibility of colonies of microorganisms in the pipelines involved in the production process (MACHEMER, 1989). In addition, microbial colonies can also occur after applications, leading to degradation of the material in which the product is applied and in aesthetic problems (GALHARDO, 2012).

In order for the biocidal product to be effective in formulations, it must have characteristics such as: not to promote undesirable effects on the product and equipment used during the production process; be effective when used in different formulations; not pose risks to the operators, nor to the user of the final product. The higher the efficacy, the lower the concentration required for the elimination of the microorganism (FAZENDA, 1995), this study is done through several laboratory tests where the main types of organisms present in certain environments and application are studied, the interactions between the active substances and these microorganisms, the definition of the types of additives that will be added to the formulation so that the active has the necessary action and the definition of the toxicity of this formulation. Thus, the proper use of the biocides can significantly improve the life of the paint in the package, the life of the coating, the necessary maintenance cycle and the protection afforded to the substrate.

The number of biocides used in the paint industry is varied, which differ from each other by the various active principles present (Table 2). The National Agency of Sanitary Surveillance (ANVISA) and the regulatory agencies of other countries seek to allow the use of biocides based on European Community Regulation No. 1451/2007. The products are classified according to 22 types and divided into 4 groups (Table 3), according to their main action target.

Table 2 – Examples of biocides and their active ingredients

Biocides	Active Substance
Formaldehyde	Formalin
Release of Formaldehyde	1 (3-chloro) -3,5-1 –azonadamantane chloride
Organomercuranes	Phenylmercury acetate; Phenylmercury oleate; Di (phenylmercury) dodecyl succinate
Cyanobutane	1,2-dibromo-2,4-dicyanobutane
Isothiazolones	MIT, CMIT, BIT, ILO, DCOIT

Fonte: Adapted from Fazenda (1995).

Table 3 – Types of biocides classified by groups

Groups	Type of Products
Disinfectants	TP 1 – 5
Preservatives (*)	TP 6 – 13
Control product of harmful animals	TP 14 – 20
Other biocides	TP 21 - 22

(*) Biocides applied to the paint industry

Fonte: Adapted from ANVISA.

One of the current applications is encapsulated biocides, which aim to provide a minimum amount of fungicide to the coating interface, with the basis of the controlled release of active by microencapsulation in an organic carrier. Another application is the use of biocides as the active principle of antifouling paints, which are used as protection systems, in order to inhibit the formation and establishment of biofouling on surfaces exposed to water, for example in boats, the friction between the hull and the water, requiring a lower demand of engine power and, consequently, a decrease in fuel consumption (KOTRIKLA, 2009).

Therefore, several companies (Table 4) seek to associate the activity of biocides with paint formulations in order to obtain a better quality material, prolonged shelf life and in a sustainable way; however, the low price is still a determining factor in the paints. For this, if you have been looking for biocides with vegetal bases, coming from renewable resources, that are not so aggressive to the environment. In the world context, the three largest consumers of paints, respectively, are North America, Europe and Brazil (IPPIC, 2015), with growth of 8.2% per year between 2010 and 2014, according to Freddy Carrillo (2017) being this area a target with growth potential.

Table 4 – Product line of companies producing biocides for the manufacture of paints

Company	Product Line
Alkaline	BC 5050; BFC 5151 T; BF 5055 AT; BF5000 T; AT 8880 A
Ashland	Nuosept 498; Fungitrol 920
Dow	Isothiazolinones; MBIT
Ipel	BP 507; BP 509; BP 560
Lanxess	Preventol; Sporgard; Azotech; Veriguard
Lonza	Proxel Triadine; Omadine
Miracema-Nuodex	Liocide 967; Liocide 711; Coryna DF; Liocide EP 2015

(*) Biocides applied to the paint industry

Fonte: Adapted from IPPIC (2015).

3. Patent Documents as Source of Information Technology

Currently in the "Age of Intelligence", methods are developed to extract the "expertise" in order to capture and disseminate technological information needed for strategic planning decisions allowing the bases of information, such as newspapers, internet and specific bases. Being that this new intelligence enables industries to identify technological opportunities and addressing practically what can affect the future growth and survival of your business technological (BUZZANGA, 2008).

In this scenario, the patent documents emerge as an excellent source of technological information, since apart from disclosing in its textual body technical information worldwide about new inventions, these documents are not exclusive use by scientists or technicians in the industry, being so important in marketing, in studies of risk analysis and strategic planning as well as in research and development (R & D) activities.

The patent documents, as to its legal effect, can be classified as: (i) documents of patent applications, and (ii) granted patent documents (or simply called Patent). The first set of documents refers to those documents are presented to the patent office for the first time, while the second concept, is alleged to have an understanding of a title granted by the state to inventors, authors or other individuals or entities in possession of rights over the creation of the invention, during the period of its validity (INPI, 2018).

As for the deposit, patent documents can be classified as: (i) priority documents, and (ii) documents the "same family". The first set of documents refer to documents that the first deposit invention prior protection be extended to other countries, this deposit is commonly done in the patent office of the country in which the invention was produced, but can also be made in another

country function of the attractiveness of the patenting process in a country, the quality of intellectual property laws (rules and costs of patenting), the patent office and general characteristics of the economy (market size, for example) reputation. While the second concept, refers to deposits made in other countries, supported by the Paris Convention ¹ (OECD, 2009).

Among the documents available in the databases of the patent documents will be studied, because they have characteristics that make them one of the richest sources of technological information, since the detailed technical description of the invention is one of the assumptions required by the international patent system, the others are: novelty, inventive step and industrial application. These documents are deposited can or can't get a title or temporary ownership of an invention or utility model (patent), granted by the State to holders - inventors, authors or other individuals or legal persons holding rights over creation. In contrast, the inventor agrees to disclose in detail all the technical content of the material to be protected by patent. During the term of the patent, the holder has the right to exclude third parties without your consent, acts related to the protected area, such as manufacturing, trading, import, use and sale (INPI, 2018).

Patent documents are classified in most patent offices, according to a unique system of coding: the International Patent Classification (IPC ²); set of letters and numbers that relate patents and they are grouped according to the technical areas to which they belong. The IPC is an instrument used in order to facilitate access to the technological and the legal information contained therein which makes the organization of the patent documents ¹ possible. Newer versions of the IPC can be accessed on the website of WIPO ³ (WIPO, 2018).

Based on the above, this article aims, through the monitoring of patent applications filed in Brazil, map and point out the evolution of the technological challenges posed by technologies involving paints containing biocides. Thus allowing the public to ensure in practice - applying the processing and application of paints containing biocides - so that the expertise acquired with respect to the technical information contained in patent documents can aggregate knowledge in the technological point of view.

¹ The Paris Convention, which in 2005 had 169 member countries, and guarantees the right of priority to depositors of patent applications in one of the signatory countries if they are left outside within 12 months.

² The International Patent Classification (IPC) is a hierarchical system in which all technological sectors are divided into a number of sections, classes, subclasses and groups. This system is essential for retrieving patent documents for the evaluation of novelty and inventive step of an invention, or to determine the state of the art in a particular field of technology and was set after the Strasbourg Agreement of 1971, which established a classification common for patents, utility models and similar titles.

³ Newer versions of IPC can be accessed on the website of WIPO or directly by <http://ipc.inpi.gov.br/ipcpub/#refresh=page>

4. Method

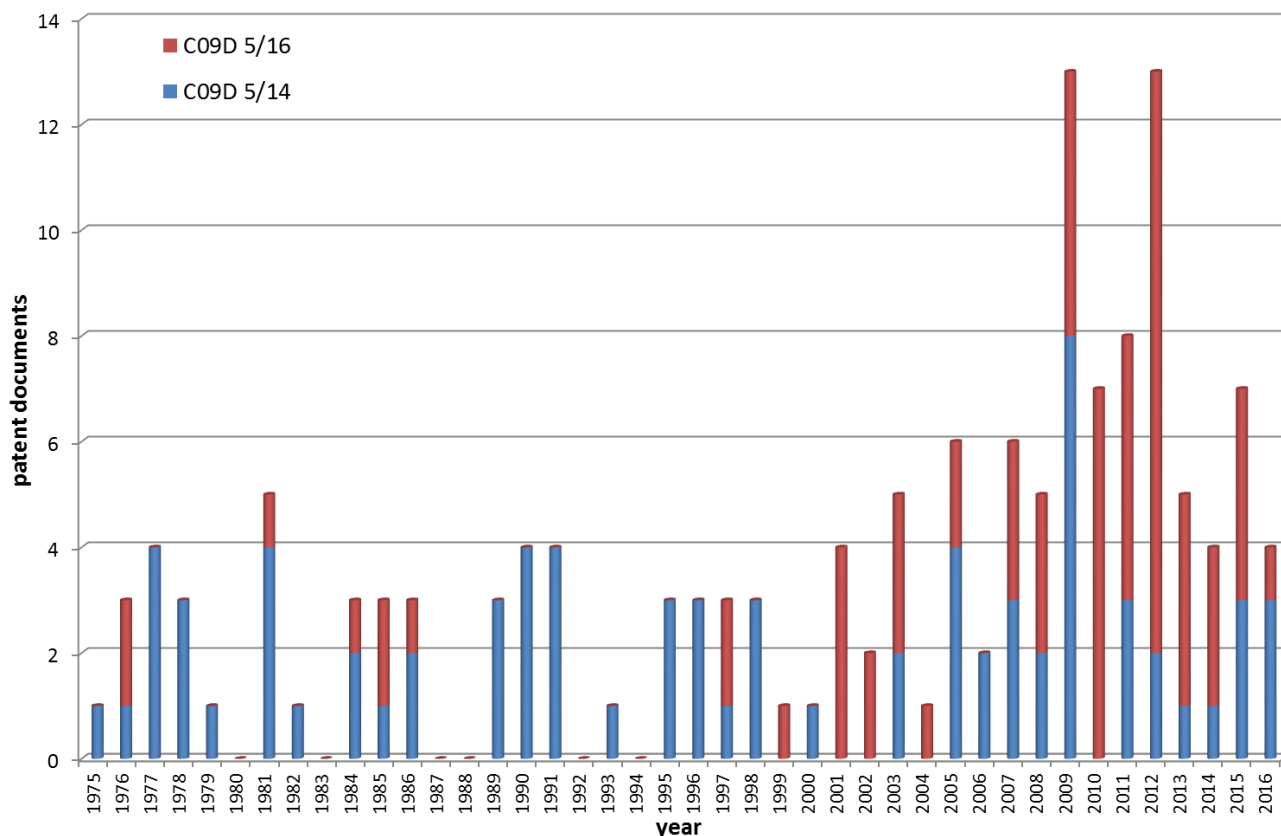
In order to evaluate the use of technologies involving paints containing biocides, due to the potential and content of the strategic information contained in these documents, the INPI-BR database was extracted and tabulated, where it sought to recover all patent applications on the use of technologies involving inks containing biocides that were deposited in Brazil.

The search strategy used to retrieve patent documents used the international patent classifications (IPC): subgroup "C09D5 / 14" and "C09K5 / 16". The period (until 2016) was chosen due to the confidentiality period, of 18 months, between the filing date and the publication date, since the orders are only available for consultation after the confidentiality period; and also due to the 30-month period that PCT periods have to enter the national phase from the filing date, applications are only available on national bases, as is the case of the INPI base, after entering the national phase and have a specific publication entering the national phase. Based on these data a quantitative analysis of the temporal evolution of the deposits, others classification (IPC) involving paints containing biocides was carried out, route of deposit, origin of protection, applicant and inventor.

5. Results and Discussion

There were a total of 145 retrieved patent documents, using for these the search strategy above. From these documents, 77 of them refers to paints containing biocides, e.g. fungicides, insecticides or pesticides (IPC = "C09D 5/14"); and, 68 of them refers to anti-fouling paints, underwater paints (IPC = "C09D 5/16"). The data were further stratified and plotted on graphs, which are displayed during the text. Below, Figure 1 shows the distribution of the number of patent documents and the temporal evolution of patent filings related to paints containing biocides in Brazil.

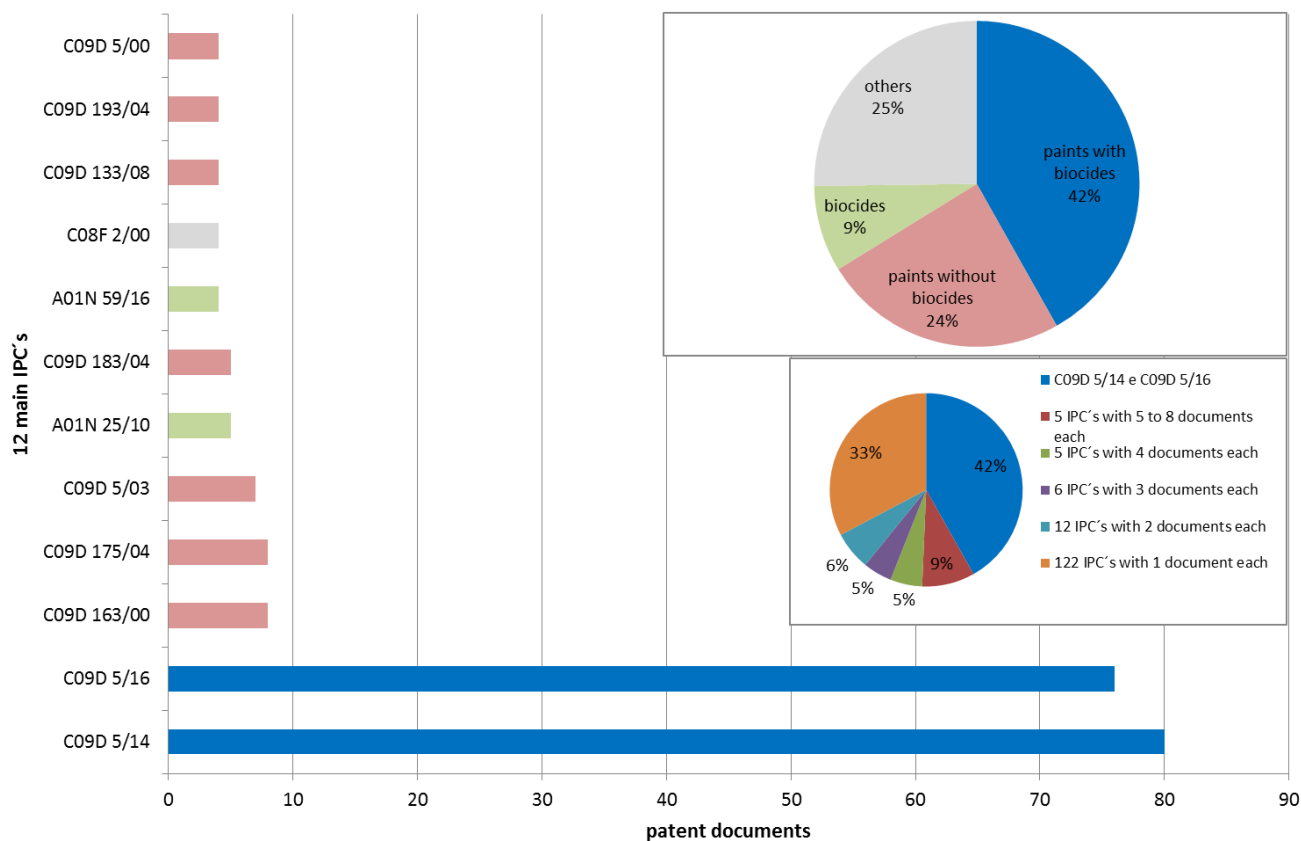
Figure 1 – Temporal evolution of patent filings in Brazil related to paints containing biocides



Fonte: Base INPI-BR (2018).

The temporal evolution of these patent filings in Brazil has the shape of an S-curve (Figure 1). The phase of the introduction, in which the number of documents deposited is small and there is a small increase, expires in 2002. The growth phase is 2001 to peak in 2009-2012 at this stage the growth in the number of filed patent documents is significant. The beginning of the decline phase, presented since 2012, may have several reasons, including: (a) the fact of referring to innovative technologies and therefore still too expensive (HAUPT, 2007).

Figure 2 – Main IPC's patent documents deposited in Brazil related to paints containing biocides

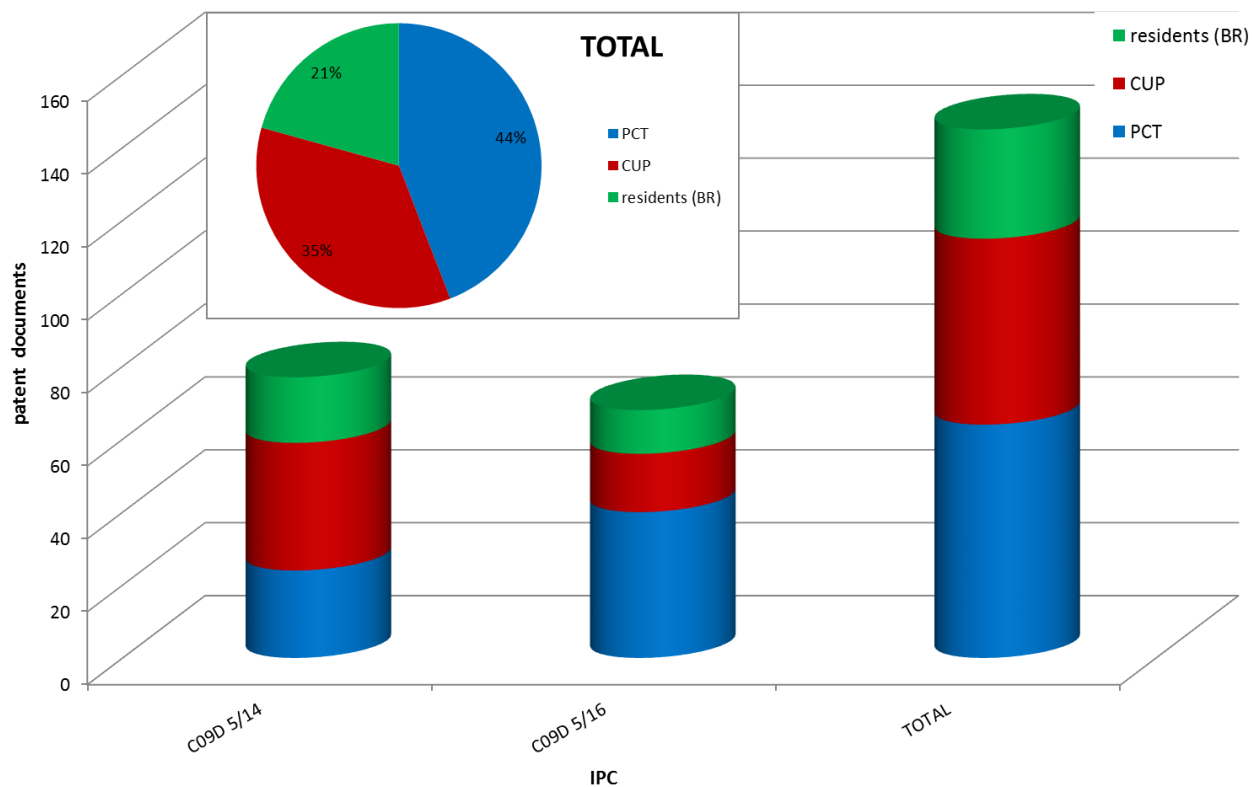


Fonte: Base INPI-BR (2018).

With respect to the international patent classification (IPC) were stratified all instances regardless of whether the first rating of the document or other document rankings and the results are shown in Figure 2. Stands out the classifications "C09D5/14" e "C09D5/16" referring to paints containing biocides (aim of these article) with 42% of the documents; the others classifications "C09D5" (refers to paints without biocides) represents 24% of the documents, and 9% of the documents refers to the biocide (IPC: "A01N25" to "A01N65"). Most of the documents refer to 1 additional IPC besides "C09D5/14" e "C09D5/16".

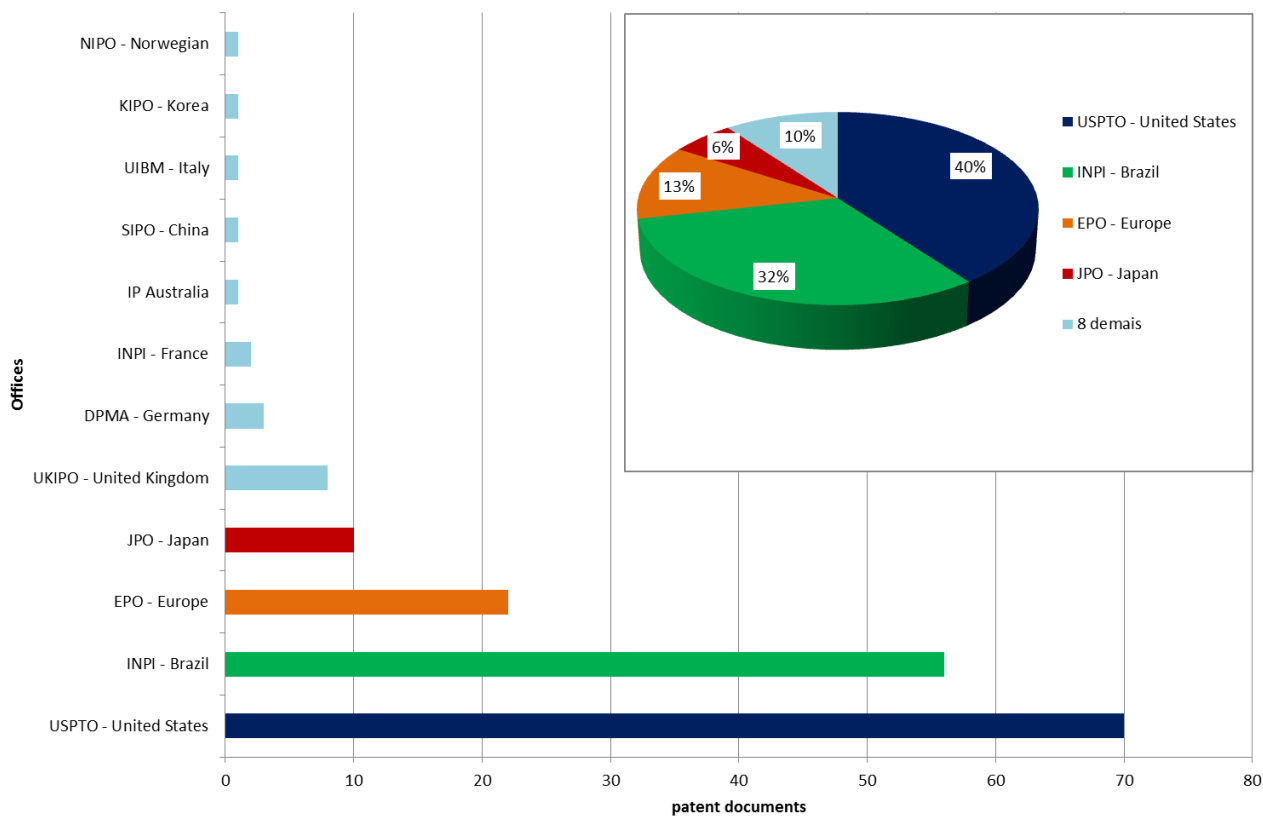
The forms of deposit are: (a) PCT (Patent Cooperation Treaty), international deposit; (b) CUP (Paris Union Convention), international deposit of a single country; and, (c) deposit of residents in Brazil. As shown in figure 3, the main forms used in general are: international deposits via PCT or CUP with, respectively, 44% and 35% (Figure 3).

Figure 3 – Form of deposit of patent documents in the IPC groups related to paints containing biocides



Fonte: Base INPI-BR (2018).

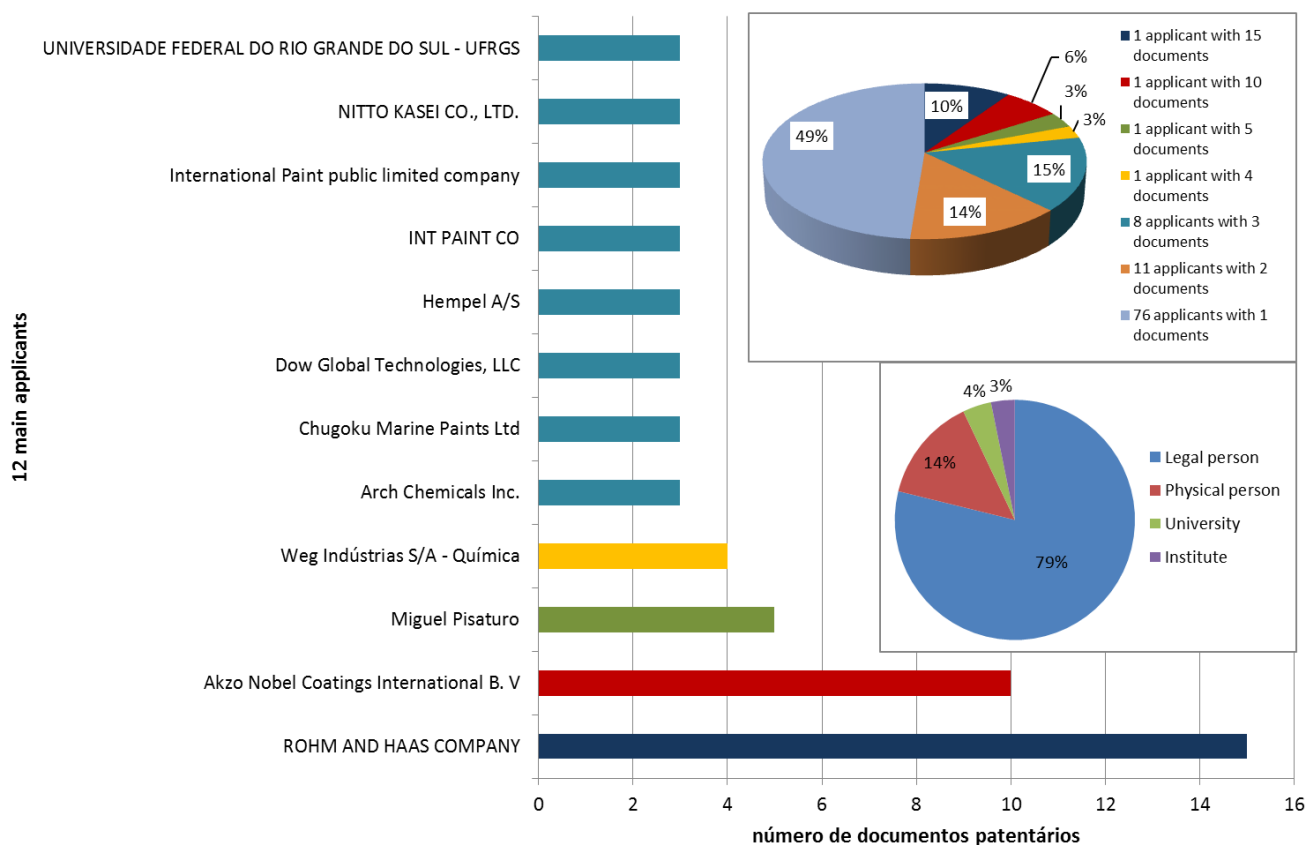
Figure 4 – Form of deposit of patent documents in the IPC groups related to paints containing biocides



Fonte: Base INPI-BR (2018).

The country of priority is the country where the patent document was deposited for the first time, before the protection is extended to other countries. It indicates the attractiveness of a country's patenting process, the quality of intellectual property regulations (patenting rules and costs), the reputation of the patent office and the general characteristics of the economy, for example market size (OECD, 2009). As there is no truly worldwide patent office, the inventor needs to have his application granted by the patent office of each country in which he wishes to have protection. Thus, it was interesting to evaluate the priority countries of the patent documents retrieved in this work. As shown in Figure 4 the distribution is concentrated, since 3 offices hold 85% of patent documents. Among them, these offices stand out: (a) USPTO - United States (40%), (b) INPI – Brazil (32%), (c) EPO – Europe (13%), and (d) JPO – Japan (6%), with 10 or more patent documents deposited related to paints containing biocides in each.

Figure 5 – Main Applicants of the patent documents deposited in Brazil related to paints containing biocides

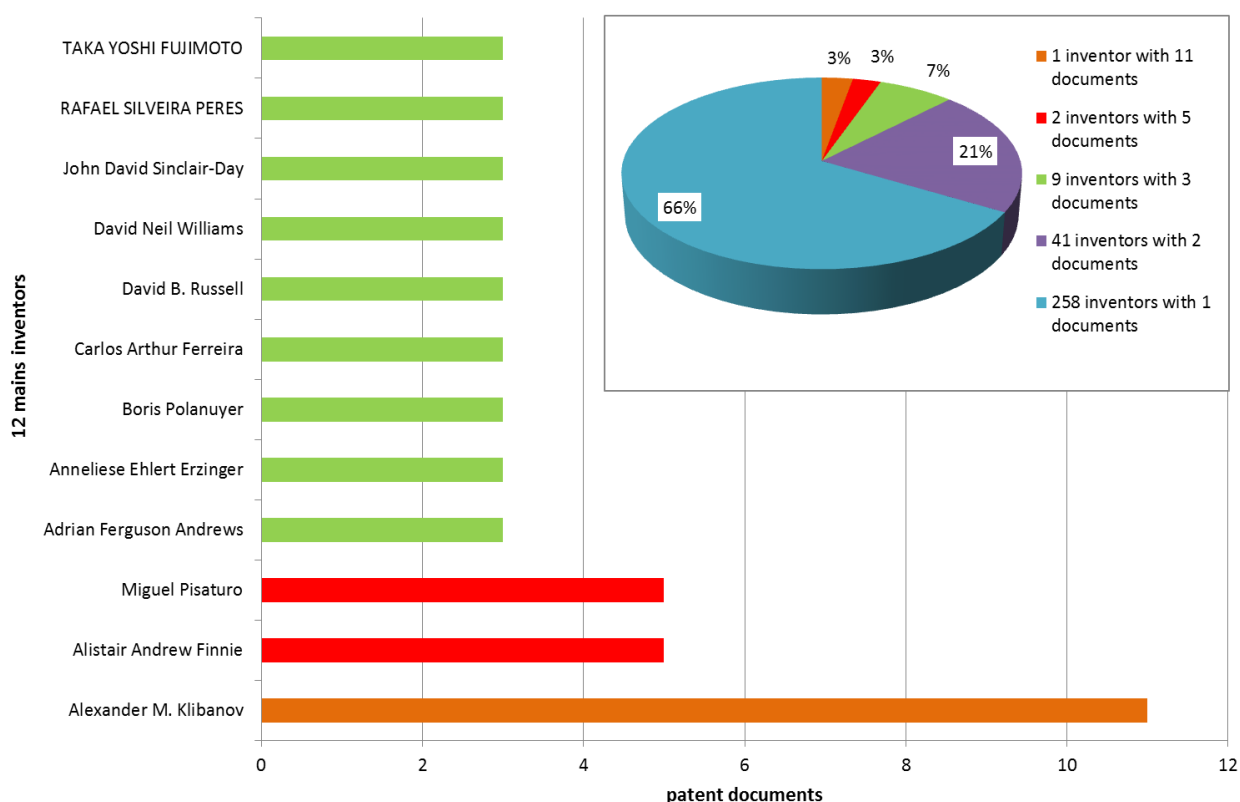


In relation to the applicants ⁴, as shown in figure 5, the applicants are distributed in a pulverized form. Among them, these applicants stand out: (a) Rohm and Haas (15 documents), (b) Akzo Nobel Coatings International (10 documents), (c) Miguel Pisaturo (5 documents), and, (d)

⁴ The applicants were analyzed according to the Legal Entity as applicant without regard to clusters.

Weg Indústrias S/A – Químicas (4 documentos). Since Rohm and Haas is a American company; Akzo Nobel Coatings International is a Dutch multinational company; Miguel Pisaturo is a Brazilian citizen; and, Weg Indústrias S/A – Químicas is a Brazilian company, corroborating with the two main countries of origin observed in Figure 4 (United States and Brazil). In addition, it is noted that most of the documents have Legal Person as applicants (79%) indicating that this market is researched by companies. Most of the applicants deposit 1 to 3 documents (78%), those 49% have only one document deposited.

Figure 6 – Main inventors of the patent documents deposited in Brazil related to paints containing biocides



Fonte: Base INPI-BR (2018).

With respect to the inventors, as observed in figure 6, the inventors are distributed in a pulverized form. Among them, these inventors stand out: (a) Alexander M. Klibanov (11 documents), (b) Alistair Andrew Finnie (5 documents), and, (c) Miguel Pisaturo - Brazilian citizen (5 documents). Most of the inventors deposit 1 or 2 documents (81%), those 66% deposited only one document.

6. Conclusion

With the execution of this work, we could demonstrate that a process of management and technological monitoring by patent documents may be very opportune for, for example, technologies involving paints containing biocides, due to the potential and content of strategic information contained in these documents.

The mapping of the timeline evolution of the filings of patent documents shows the historical evolution of the patent protection of a technology on a topic / subject over the years, and from this it was possible to conclude that the number of filings in this period from 2001 start going up and peaked in 2009-2012 and started dropping because of several reasons, including: (a) the fact of referring to innovative technologies and therefore still too expensive (HAUPT, 2007).

With respect to the international patent classification (IPC), they should be divided in three groups: (a) paints containing biocides (IPC "C09D5/14" e "C09D5/16") with 42% - aim of these article; and secondarily classified also in: (b) pains without biocides (IPC "C09K5" different of "C09D5/14" e "C09D5/16") with 24%; and biocides (IPC: "A01N25" to "A01N65") with 9%.

Regarding the forms of deposit, they are: (a) PCT (Patent Cooperation Treaty), international deposit; (b) CUP (Paris Union Convention), international deposit of a single country; and, (c) deposit of residents in Brazil. in the case of the technologies involving paints containing biocides it could be concluded that the main forms used in general are international deposits via PCT or CUP with, respectively, 44% and 35%.

As to the origin of protection of technologies, this is in countries covered by the offices of industrial / intellectual property in which patent documents are deposited in the first place in the case of the technologies involving paints containing biocides it could be concluded that they are: (a) USPTO - United States (40%), (b) INPI – Brazil (32%), (c) EPO – Europe (13%), and (d) JPO – Japan (6%).

With regard to applicants, these are mostly made by companies (Legal Person) representing 79% of the documents, especially the American company Rohm and Haas (15 documents), the Dutch multinational company Akzo Nobel Coatings International (10 documents), the Brazilian citizen Miguel Pisaturo (5 documents), and, the Brazilian company Weg Indústrias S/A – Químicas (4 documentos).

With regard to the inventors, they are distributed in a pulverized form; among them, stands out: (a) Alexander M. Klibanov (11 documents), (b) Alistair Andrew Finnie (5 documents), and, (c) Miguel Pisaturo - Brazilian citizen (5 documents).

From the above, it can be concluded that most of the patents containing biocides related patent documents involves innovation in the paint originating in the United States.

References

- Fazenda, J. M. R.; **Tintas e Vernizes: ciência e tecnologia**. 2ª edição. São Paulo: ABRAFATI, 1995. Volume 1.
- Galhardo, C. M.; **Biocidas em preparações pigmentárias - Biodeterioração de tintas e a importância do uso de biocidas**. Monografia (Monografia apresentada como requisito parcial para a conclusão de Graduação do Curso de Engenharia Bioquímica – Escola de Engenharia de Lorena da Universidade de São Paulo). 2012. Disponível em: <https://sistemas.eel.usp.br/bibliotecas/monografias/2012/MBI12009.pdf>. Acesso em: 02/07/2018.
- Kotrikla, A. Environmental management aspects for TBT antifouling wastes from the hipyards. **Journal of Environmental Management**, 90, pp.S77-S85. 2009.
- Machemer, W. Controlling Biological Contamination in Coatings Manufacturing Processes. **Modern Paint and Coatings**, Edição de maio de 1989. 1989.
- Moragas, M. D. O., Schneider, W. M. Biocidas: Suas Propriedades E Seu Histórico No Brasil. **Caminhos de Geografia**, v.4, n. 10, pp.26–40. 2003. Disponível em: <http://www.seer.ufu.br/index.php/caminhosdegeografia/article/view/15315>. Acesso em: 02/07/2018.
- Haupt, R., Kloyer, M., Lange, M. Patent indicators for the technology life cycle development. **Research Policy**, 36 pp.387–398. 2007.
- INPI – **Instituto Nacional de Propriedade Industrial**. Disponível em: <http://www.inpi.gov.br>. Acesso em: 02/07/2018.
- IPPIC – International Paint & Printing Ink Council. **Global Market Analysis For The Paint & Coatings Industry (2015-2020)**. Disponível em: <https://ippic.org/#global>. Acesso em: 02/07/2018.
- OCDE - The Organisation for Economic Co-operation and Development. **OECD Patent Statistics Manual (2009)**. Disponível em: <http://www.oecd.org/sti/inno/oecdpatentstatisticsmanual.htm>. Acesso em: 02/07/2018.
- ROBINSON, N. A.; **Environmental Law Lexicon**. New York: Law Journal Press, 2005. page: B-7
- SAUER, F.; **Microbicides in Coatings**. Hanover: European Coatings Library, 2017.
- WIPO REFORMED IPC. Disponível em: <http://www.wipo.int/ipcpub/#lang=en&refresh=page>. Acesso em: 02/07/2018.
- WYPYCH, A. and WYPYCH, G.; **Databook of Biocides**. Toronto: Elsevier, 2015.